2003 WRIA 9 JUVENILE SALMONID SURVIVAL ASSESSMENT PROJECT

PURPOSE

The purpose of the study is to establish a baseline for the behavior of juvenile chinook and other salmonids in the lower 34.5 miles of the Green and Duwamish Rivers and adjacent nearshore areas of WRIA 9. The study will concentrate on collecting information regarding natural chinook salmon growth, timing of migration, feeding, life history types and interactions with hatchery salmon. The study is organized to assess juvenile survival within four distinct geographical reaches of the lower 34.5 miles of the Green/Duwamish Rivers and Elliot Bay nearshore. The information will be used to make short-term conservation decisions as well as establishing a long-term baseline to gauge the effectiveness of ESA recovery actions.

Little is known about naturally produced chinook juvenile behavior and survival within the Green/Duwamish River system and nearshore. Prior juvenile chinook studies have been confounded by hatchery supplementation because hatchery salmon could not be readily distinguished from natural salmon. Two recent efforts on the Green River will allow new studies to reveal the behavior of natural chinook for the first time. The two efforts are: (1) the 2001 initiation of a program to mass mark juvenile hatchery chinook (adipose fin clip) which identifies the hatchery stock, and (2) the operation of a screw trap, beginning in 2000, at RM 34.5 that is capable of estimating natural chinook and other salmonid production, timing, and size. These two efforts are important initial steps to begin separating and understanding the behavior of hatchery and natural Green River chinook. The proposed study will take advantage of these efforts to differentiate and compare natural and hatchery outmigrants in the Lower Green River (RM 32.0 to 11.), Duwamish River (11.0-0.0) and the nearshore areas of Puget Sound.

The screw trap has revealed that natural juveniles use at least two strategies for outmigration. A group of 40 mm-long juvenile chinook "fry" outmigrates from January through March, and another group of 70 mm "fingerlings" moves out from mid-May to mid-June. Little is known regarding the behavior and habitat use of the two juvenile life strategies downstream of RM 34.5. Understanding how the natural chinook currently use the Green/Duwamish Rivers and nearshore is a necessary step to designing recovery actions that will promote the survival of the Green River chinook population.

Current information can be combined with findings from other studies and research to build a model of how the Green River population may be using the current WRIA 9 habitat. That model can be used to assist researchers in formulating strategic questions and testable hypothesis that lead to a better understanding of chinook habitat use in the watershed and nearshore. As new information is revealed from WRIA based studies, the model is updated and refined. To begin this effort, a hypothetical model, which was initiated to guide all WRIA 9 research, is presented as follows:

MODEL OF NATURAL CHINOOK SALMON PRODUCTION

The following model is based on juvenile chinook salmon patterns observed from a variety of studies in the Pacific Northwest (Reimers 1971, Healey 1980, 1991, Levings 1984, Simenstad and Wissmar 1984, Beamish et al. 1998, Beamer et al. 1999, Seiler et al. 2002). Some key factors affecting juvenile chinook salmon are shown in Figures 2, 3, 4, and 5. Additional factors are listed in subsequent sections of the report.

After emergence, some chinook salmon fry (~35-40 mm) remain upriver whereas others (typically the majority) begin moving downstream soon after emergence (Healey 1991, Seiler et al. 2002). Downstream movement of these "fry migrants" may be dependent on available habitat (capacity), which varies with flow. Some fry apparently move quickly to and possibly through the estuary, while others undergo a slow rearing migration. Higher than normal flows may reduce fry habitat (capacity), leading to greater movement downstream. Some fry movement is voluntary, but some is not. In a given year, large emergence of chinook fry may lead to greater fry movement downstream if upstream habitat is fully utilized. Migrant fry may seek out suitable habitat for rearing/growing in the lower river prior to entry to the estuary, move directly into the estuary for rearing (by choice or by lack of refuge), or quickly move through the estuary and rear along nearshore marine beaches. Fry remaining upriver grow and experience some mortality, then actively migrate downstream late in the spring at a relatively large size ("fingerling migrants") (Healey 1991, Seiler et al. 2002). The size of late migrants compared with early migrants of similar age (days) has rarely been directly compared, but it has been hypothesized that juveniles in estuarine areas grow more rapidly than those in freshwater habitats. However, Healey (1980) suggested growth of subyearling chinook salmon in the estuary and river can be similar.

Fry moving downstream typically seek shallow water habitat that is protected from strong currents or wave action along their migration route (lower river, transition zone, estuary, and nearshore). If rearing "requirements" are met (prey availability, water velocity and temperature, salinity, depth, cover, etc., few competitors, few predators), they remain until reaching some threshold size and/or age. If some or all rearing requirements are not met, they most likely move (typically downstream, although possibly upstream with flooding tide, or into off channel habitat). Unfavorable or crowded habitats may lead to displacement and more rapid downstream movement at smaller size (Beamer et al. 1999), possibly leading to greater vulnerability to predators and less ability to negotiate key life history transitions (entry to high salinity seawater and oceanic environment)[1]. These individuals would likely be smaller than those finding suitable habitat. Chinook fry are surface oriented where there is a natural range of salinities in estuarine areas. A narrow band in the upper water column of the lower "estuary" is brackish and may be sought by smaller salmon that might be less developed in the smoltification process. Intertidal habitat utilization by juvenile chinook salmon is dynamic because habitat availability and habitat qualities vary with tide level. In nearshore marine habitats, juvenile chinook salmon rear, grow and migrate for days or possibly weeks before moving to epipelagic waters of Puget Sound. Most subyearling chinook salmon rear in inshore marine areas until at least fall (Healey 1980).

Migrant fingerlings actively move downstream from upper reaches after growing for a month or more. Although fry versus fingerling migrants can be generally described in terms of age (days) and size, the transition between the two categories is gradual rather than abrupt. Fingerling migrants may seek habitats for additional feeding and refuge, possibly residing in the lower river and estuary for a shorter time compared with migrant fry. It is not known if fingerlings utilize habitat differently than fry in each geographic region (lower river, upper estuary, lower estuary, nearshore), but Healey (1980) noted that fry migrants disappeared from nearshore waters prior to the arrival of fingerling migrants in late May. Habitat use by various chinook salmon life history patterns is an important aspect of the research framework, especially from the perspective of identifying and maintaining species diversity.

Stream-type chinook salmon (i.e., juveniles that overwinter in the watershed before seaward migration) is a life history

[1] The compensatory mortality described here leads to the typical Ricker or Beverton-Holt recruitment curve.

type that is presently rare in the Green/Duwamish watershed[2]. Conceivably, the frequency of naturally-produced stream-type chinook salmon could increase after the ACOE installs a fish passage system in Howard Hanson Dam and chinook runs are established in the upper Green River.

There may be a variety of chinook life history patterns within the general subyearling pattern. It is also possible that a variety of patterns naturally existed that have been lost due to harvests, genetic alterations of the population, and habitat modifications. These patterns may be defined largely by variations in body size and the duration that they utilize river, estuary, and nearshore habitats. Identification of life history patterns and factors supporting each life pattern is an important aspect of the research framework because greater diversity in life history patterns (either genetically or environmentally based) is likely to lead to greater long-term stability and persistence of a population, especially when confronted with changing climatic regimes (NMFS 2000). Thus, identification of existing life history patterns and key factors supporting them is an important research function, in addition to identifying factors affecting overall survival and abundance of juvenile chinook salmon.

2003 PROPOSED PROJECT

Naturally produced Green River chinook will be captured at RM 34.5and Soos Creek with screw traps, marked with fluorescent pigment, then recaptured at RM: 13.0, 7.0, 1.0 and in Elliott Bay using seines, screw traps and an Onieda trap net. At each sampling site the following will occur: (1) identification and enumeration of all fish, (2) salmonid fork length measurement (3) salmonid mark identification (fluorescent pigment, adipose clip), (4) chinook otolith extraction, and (5) scale collection and gut content collection. All fish not utilized for otolith and food habitat analyses will be returned live to the river.

By strategically locating the sampling sites the project attempts to sample four morphologically and geographically distinct habitat types, those are:

Free Flowing River (RM 34.5 to 13.0)

In this reach the river moves steadily downstream even at the most downstream point where the flows are influenced by the tides. Historically, this was an area that was frequently inundated by freshwater flood flows from the Green and White Rivers creating an extensive wetland area with beaver ponds and a slow moving meandering mainstem. The historic habitat was expected to have contained freshwater rearing habitat (as described in the model) for juvenile chinook. Today the reach is highly modified with hardened banks and diverted flows (the White River) so the rearing habitat is expected to have been adversely impacted.

Tidally Flooded Freshwater River (RM 13.0 to 7.0)

This reach is under a stronger influence of the tides and the flows slow, stop, and reverse on a regular basis. This area is similar to the historic and current habitat description of RM 34.5 to 13.0, but flooding occurred on a more regular basis probably resulting in formation of some tide channels. It also was expected to have been used by chinook juveniles for freshwater rearing. Today, due to tidal action it has the lowest velocities of any freshwater mainstem reach downstream of RM 34.5 and may be used by juvenile chinook for a proportionately longer period of rearing.

[2] Stream-type chinook salmon are often produced by spring-run chinook salmon, although they can also be produced by summer/fall run fish. Most stream-type natural chinook salmon may have been lost when the White River diverted to the Puyallup drainage in the early 1900s. The Soos Creek Hatchery releases numerous yearling chinook salmon from Icy Creek ponds.

Duwamish River Estuary (RM 7.0 to 0.0)

The salt water wedge regularly reaches RM 7.0, and sometimes moves upstream, therefore making this reach continually estuarine. Over 97% of the historic estuarine mudflats, marshes and forested riparian swamps have been eliminated by channel straightening, draining, dredging and filling in this reach. Still the estuary provides an important physiological transition zone for migrating salmonids and remnant feeding areas as described briefly in the model.

Nearshore of Puget Sound

For this study, the Puget Sound nearshore comprises intertidal and adjacent shallow subtidal areas along shorelines of WRIA 9 (Elliott Bay, Vashon Island, and Central Puget Sound mainland). The nearshore has been highly modified by hardening and filling of the shoreline as well as dredging, pier construction and other detrimental activities. The water is typically more saline than the Duwamish River Estuary reach and a difference in fish use is expected as the salinity and other habitat parameters change. Green River chinook are expected to be more difficult to sample with distance from the Duwamish. Sampling will probably be focused in Elliott Bay.

STUDY QUESTIONS

The proposed 2003 study addresses the following questions and hypotheses:

Questions #1, Duration of Juvenile Chinook in River Reaches:

Do the study reaches differ in duration of use by the early (~40 mm long) natural chinook outmigrants (fry)?

Do the study reaches differ in duration of use by the later (~70 mm long) natural chinook outmigrants (fingerlings)?

Do the study reaches differ in duration of use by hatchery chinook outmigrants?

Do natural fry migrants from Soos Creek and the mainstem Green River (RM 34.5) differ in duration of use of the study reaches?

Do hatchery fish and natural chinook differ in duration of use of the reaches?

Does migration time through the reaches in the river change with the season?

Null hypothesis:

Duration estimates from marked chinook do not significantly differ respective to A, B, C, D, E, and F above.

Test Method:

Marking of natural fry at the Soos Creek and at the WDFW RM 34.5 screw trap, then collection at RM 13.0, RM 7.0, RM 2.0 and nearshore beaches west of Duwamish River mouth on at least a once per week basis from February 1 to approximately August 15. Three pigment colors will be used to spray mark the chinook probably orange, chartreuse and blue. Each pigment will be used for a maximum of one week period. Mark identification and fork length measurements will be taken from chinook collected at each sampling site and the information used to estimate duration of chinook in each reach.

If funding and fish are available, natural fingerlings captured at the RM 34.5 screw trap may be marked using elastomer dye or PIT tags and duration estimated similarly to the fry.

Hatchery fingerlings will be adipose clipped prior to release and that mark will be used to identify their presence and to estimate reach specific duration.

Question #2, Juvenile Chinook Size and Growth

Do the study reaches differ in size and growth of the early, about 40-mm long, natural chinook outmigrants (fry)?

Do the study reaches differ in size and growth of the later, about 70-mm long, natural chinook outmigrants (fingerlings)?

Do the study reaches differ in size and growth of hatchery chinook outmigrants?

Do the natural fry migrants from Soos Creek and the natural fry captured at RM 34.5 of the Green River differ in size and growth through the reaches?

Does hatchery and natural chinook size and growth differ in the study reaches?

Does early otolith growth increment differ between natural fry and fingerling outmigrant chinook?

Null hypothesis:

Size and growth estimates from marked fish, using length and otolith measurements does not significantly differ respective to A, B, C, D, E and F above.

Test Method:

All or up to 100 wild and hatchery chinook at each site and each sampling session will be measured (fork length) to the nearest millimeter. Using this information, size and growth for each reach will be estimated by plotting fish size ± SE at each location against date of capture. Changes in fish size over time at each site provides an index of growth rate, assuming random sampling. Comparison of growth curves between sampling stations provides an index of growth occurring in habitats between stations. Length frequency distributions of juveniles by date and station will be examined; broad distributions will likely reflect, in part, differing duration in upstream habitats.

In addition, 40 natural chinook per month per location will be sacrificed for otolith collection. The otoliths will be used to estimate an average growth rate index from emergence to capture based on fish length and daily age of individuals (otolith rings). Otolith increments may also identify groups of juveniles with similar growth patterns that may help identify various chinook-rearing strategies by capture date and location. Juvenile strategies could be linked to adult survival and the information used to customize recovery efforts for the watershed.

Pigment color will be used to differentiate the Soos Creek fry from the RM 34.5 fry and the presence or absence of adipose fins will be used to differentiate the wild fingerlings from the hatchery ones.

Questions #3, Prey Consumption by Juvenile Chinook

Do hatchery releases of 0+ chinook affect prey consumption of natural chinook?

Does prey consumption and stomach fullness per study reach change over time and in relation to fish abundance?

Null hypothesis: Prey consumption estimates from gut samples of natural and hatchery fish do not significantly differ respective to A and B.

Test Methods: Gut samples will be taken from the same natural chinook used for otolith collection (40 per month per site sampled) and analyzed for prey composition and prey weight. Hatchery fish will also be sacrificed for gut collection and compared with the natural fish prey items and abundance.

SITES AND SAMPLING METHODS PROPOSED

RM 34.5 Washington Department of Fisheries (WDFW) Screw Trap Location.

This is a site that collects primarily naturally produced salmonids. The site was first used in 2000 and is successful in estimating the production of the primary chinook natural spawning areas upstream. The trap captured almost sixty thousand chinook in 2001 during two distinct peaks in the outmigration; one peak occurred in March the other in late May and June. Chinook were about 40 mm average during the early peak and about 72 mm in the later in 2000(Seiler 2002). Most of the chinook hatchery production enters the Green River via Soos Creek (RM 34.0) which enters downstream of the WDFW screw trap. WDFW is responsible for the permits to operate the screw trap.

Proposal: Spray mark (with unique color) chinook for a one week period during the early peak (late February to early March). We will attempt to sample the peak migration and mark about 10,000 chinook. Regular communication with the WDFW screw trap staff will facilitate the time to mark salmon. Elastomer marking technique or PIT tags may be used to identify the later mode of the outmigrants (70 mm fingerlings). The goal is to mark 10,000 of the larger juveniles. Sacrifice 40 chinook from each time period for gut, otolith and scale samples.

WDFW Green River Hatchery at Soos Creek RM 0.5:

In recent years the hatchery has released between 3 and 4 million chinook fingerlings (about 80mm) during late May and early June. No proposed marking of the hatchery fish beyond the anticipated WDFW adipose removal. If agreeable to WDFW we may possibly hold some natural fish for mark mortality and retention studies at hatchery. Permission from hatchery manager not yet given.

Soos Creek Screw Trap Location RM 0.8:

This creek was trapped in 2000 by WDFW and captured ninety thousand naturally produced juvenile chinook mostly during a one month period from mid February to early March. The trap is placed upstream of the hatchery and the juvenile production is influenced by the placement of three to four thousand excess hatchery adults upstream of the hatchery weir.

Proposal**:** Capture (using screw trap) and spray mark 40,000 juveniles during the peak migration period for two consecutive weeks. Use one color for a maximum of one week and another color for the next week. Gather otolith, gut and scale samples by sacrificing 40 chinook salmon from each week. To increase marking efficiency we may find it necessary to use a fry holding cage placed in a pool near the trap site.

RM 13.0 Seining and Screw Trap Site:

This site will capture fish that have passed through a free flowing Green River reach from RM 34.5 to 13.0. The reach is highly modified by rock revetments and provides little low velocity rearing for salmon. The site at RM 13 is the only beach large enough to use a conventional seine in the lower end of the reach to be studied. This site has been seined for the previous two years and found efficient for collection of juvenile chinook when flows are between 300 and 2,500 cfs. (Nelson 2003, in prep).

Proposal**:** Capture chinook and other fish using seine and a screw trap. Once marking is complete at Soos Creek, the screw trap would be transported and placed at RM 13.0 (possibly in early March). All collected fish would be identified, enumerated and checked for marks. Salmonids would be measured (up to 100 wild and hatchery chinook per session). All fish are intended to be returned live to the river except for the intentional, sacrifice of 20 natural chinook and 20 hatchery chinook for otolith, gut and scale samples every two weeks. Seining would occur at least twice a week during periods of high outmigration and night effort may be targeted to increase catch size.

RM 7.0 Seining Site

This site will capture fish that have migrated from 13.0 to 7.0 which is a reach of tidally influenced freshwater habitat. Twice a day, due to tide action, the velocities in this reach slow and sometimes reverse direction. Behavior and duration of use in this reach may vary from the free flowing reach due to lessened flow velocity and the proximity to salt water which is immediately downstream of RM 7.0.

Proposal**:** Seine methods and effort same as at RM 13.0 except without use of the screw trap

RM 1.0 Onieda Trap Site

This site would sample the fish residing in the Duwamish River estuary/transition zone reach (RM 7.0 to 1.0) and represent fish as they leave to enter marine nearshore habitat.

Proposal**:** An Onieda trap which is described and used successfully in Port of Seattle studies (Weitkamp, 1982) would be used to collect fish. The same information as collected upstream at RM 7.0 and 13.0 will be collected from the trap catch. The trap would be operational at least three days a week, throughout the study.

Nearshore Seining

Several beaches along the shorelines of Elliot Bay would be sampled beginning in February. This sampling will identify habitat and timing of chinook in the nearshore.

Proposal**:** Beach seine method and collection of same data and chinook tissue samples (otolith, gut and scale). Sampling should occur twice per week during the early migration period when marked chinook are expected to be more prevalent.

RESOURCE ESTIMATES AND NEEDS PER SAMPLING SITE

Estimates are preliminary, cost savings may be found in combining tasks, recruiting other WRIA partners or scope changes if necessary
Estimates of labor are based off a $50 average hourly labor rate (includes overhead)
Eight hour work days are used for estimation purposes, therefore one work day =$400
Project management and report writing estimated at $85 per hour (includes overhead)

WDFW Screw Trap Site RM 34.5

Task	Status as of 1/07/2003	Cost Estimate	
Operate screw trap	WDFW funded ($100,000)		
Spray mark chinook	King County/KCD funded	Two people, ten days	$8,000*

Soos Creek Screw Trap

Task	Status	Cost Estimate	
Purchase Screw Trap	Manufacturer ready to deliver		$17,000
Operate Screw Trap and Mark Fish	King County/KCD funded	Two people, 60 days	$48,000*

RM 13 and 7 Seine and Screw Trap

Task	Status	Cost Estimate	
Seine	King County KCD/KC funded	Three people, two days per week, six months, (52 days x $1200)	$62,400*
Operate Screw Trap at 13.0	King County partial, recruit for help (Tukwilla?)	Two people, 1/2 day, five days per week 4 months (85 days x $400)	$34,000*

Duwamish Onieda Net(s) and Seining

Task	Status	Cost Estimate
Operate Net	Net may be available from NRC, otherwise a purchase is needed. Hope to recruit help (Port of Seattle?)	Four 1/2 days per week, two people for six months (52 x $800) $41,600
Seine Elliott Bay	Hope to recruit	Two days per week, three people for 6 months, cost savings accrued by combining the two efforts. Estimate assumes adding one extra person to the task above two times a week and having all three people work a full day. (52 days X $800) $41,600
Purchase Onieda Net		$2,500

Report and Project Management-King County

Task	Estimate	
Project Management	80 hours	$6,800*
Write report for 2003 season	12 weeks, five days per week (60 days x $680)	$40,800*

Other Expenses

Task	**Estimate**
Laboratory fees (otolith, scales, guts)	$15,000
Equipment	$5,000
Rental	$2,000

Total Cost **$324,700**
King County In-Kind (Labor) **$160,000 - $100,000**
KCD Grant **$83,000**

Total Unfunded (as of 1/10/03) $141,700 - 81,700

NMFS SCIENTIFIC COLLECTION PERMIT MODIFICATION INFORMATION

The following is a summary of items that need to be included via modification into the existing permit which King County currently holds:

Lethal take of natural chinook:

* Up to 1,040 natural juvenile chinook will be taken for gut and otolith analyses. This estimate of directed take is based on collection of 40 natural chinook salmon per month (March through July) at each of the stations sampled (40 at Soos Creek, 200 from RM 34.5, RM 13.0, RM 7.0, RM 2.0 and the nearshore). Assuming a survival rate of 0.4% (i.e., the average survival of Soos Creek hatchery chinook) these 1,040 chinook salmon would produce approximately four adult chinook salmon. This take estimate is exceptionally small compared to the annual take of natural Green River chinook salmon in commercial, sport and tribal fisheries. The take of 40 natural juvenile chinook per month per station is necessary to statistically compare growth and food contents of natural salmon between sites and to compare natural chinook prey consumption with that of hatchery chinook salmon. Incidental mortalities of natural chinook, as a result of capture, will be used for otolith and diet analyses. To minimize the sacrifice of natural chinook, each fish will be used for both gut and otolith collection. Some chinook are expected to be too small to safely use gastric lavage (about 40-70 mm) which necessitates the sacrifice for gut sampling.

Screw Trap operation at Soos Creek and at RM 13

Take of chinook expected to be minimal using this method. Handling of approximately 40,000 chinook salmon fry in Soos Creek and up to 30,000 salmon at RM 13 is anticipated. A crew person will be at the project site everyday during the operation of the trap to ensure that the holding box does not become crowded and fish unduly stressed.

<u>Justification</u>: the least impacting way to collect chinook for marking. The method has already shown to be successful at capturing chinook salmon with very little incidental mortality. The screw trap could increase sampling power at RM 13.

Additional marking of chinook

The existing permit allows for marking of (??5,500check on exact #??) chinook. We are asking to increase the number of marked fish to 60,000 (40,000 spray marked fry at Soos Creek, 10,000 spray marked fry at RM 34.5, 10,000 PIT tags or elastomer marked fingerlings at RM 34.5.Spray marking is currently the only method of mass-marking natural chinook fry which provides for nonlethal recovery. It has been used with success marking hatchery fingerlings in a 2002WDFW project in Sinclair Inlet (less than 1% mortality) and Phinney et al. (1967) reported that mortality associated with spray marking was negligible. Although the small size of the early migrants we intend to mark may increase the injury risk, Healey (1980) reported less than 5% mortality while spray marking chinook fry in the Nanaimo River, British Columbia. Estimates of immediate and delayed (24 hr) mortality will be documented by holding marked fish in cages before release

*<u>Justification</u>: Large numbers of marked salmon are necessary in order to recapture sufficient numbers of salmon for the purpose of estimating duration between mark and recapture at each station. Recent experience with proposed gear at each sampling area has shown that catch per effort of subyearling chinook salmon is low. Seiler et al. (2002) estimated approximately 1.08 million natural subyearling chinook salmon migrated downriver in 2000. Marking 40,000 chinook salmon represents less than 4% of the 2000 migration. Potential mortality from spray marking would be 2,000 fish if 5% of these fish were killed. The adult equivalent mortality is eight adult salmon, assuming 0.4% survival.

Onieda Trap Operation

The operation of an Onieda trap will increase sampling power in the Duwamish River relative to seining. Weitkamp (1982) found the Onieda trap to be efficient at capturing salmonids in the Duwamish River and the trap can be operated with minimal mortality of chinook. Incidental mortality of <25 natural chinook salmon is anticipated by this passive gear. Mortalities can be minimized by placing the holding compartment of the net in an area that does not dewater on a receding tide.

Quality Assurance/Quality Control

Field Sampling: All field personnel will have experience and/or training in field sampling, fish identification, and safety protocols. Sampling methodology will be based on that described by Nelson (2002). A daily sampling plan and schedule, including personnel effort, will be developed.

Data collected at each site will be recorded on project-specific, water-proof data sheets. Fish will be identified and measured live at the sampling station. Heads of juvenile chinook salmon will be removed and individually preserved in ethanol for extraction of otoliths at the lab; an attached data label will identify date, station, fish number, mark type, and length. The salmon carcass will be preserved in 10% formalin, along with appropriate label information, for diet analysis.

Data Management: Data sheets will include names of field personnel so that questions, if any, can be addressed to the appropriate individuals. Data sheets will be delivered to Tom Nelson at the end of the sampling day or on the next appropriate day. Data will be entered into a database and checked for accuracy on a regular basis so that sample sizes and in season data analyses can be conducted. Otolith and fish gut samples will be delivered to Tom Nelson, along with the datasheets, and stored at King County office.

Data Analysis: Need to describe how data will be used to test each hypothesis/question: timing, growth, diet: Should we assume you will look at otoliths?? Yes, sooner or later when funding permits.

You might consider increasing # of sampling days per week at 1 or 2 river stations in order to develop duration estimates---just for fish marks (not guts and otoliths). Otherwise, I think your chance of estimating duration will be limited. The duration test is the most difficult to estimate and requires the most sampling effort. Take a look at Wetherall recapture info for timing of hatchery fish. Yes I agree, I will see how my funding holds up, for now I'll budget for at twice a week at 13 and 7, hopefully an event that goes from AM of day one through evening Day 1 and 2, then again on Day 2. So we would get two days and one night session from each.

Note to Greg and Don:
This sheet is for my own reference and subject to change; no need to review or edit unless you see an obvious need.

Sampling Schedule 2003

Date	Action
February 1	Screw Trap RM 34.5 and at Soos Creek are operational
February 8	Seining at RM 13, 7, nearshore begin, Duwamish Onieda trap operational. *Seining occurs at least twice a week, Onieda 3 fishes at least three days per week.
February 20 (approx)	Spray Mark color #1 at Soos Creek begins
February 27 (approx)	Spray Mark color #2 at Soos Creek begins, #1 ends
March 5 (approx)	Spray Mark color #3 at RM 34.5 screw trap
June 20	Seining, trapping effort reduced until August 15

Labor Budget

Site	Effort	Approximate Cost	Totals
RM 34.5 Marking	7 days in one week	2 people X $300 X 7 days	$4,300
Soos Creek	Trap setup, maintenance, fish processing	2 people X $300 X 28 days	$16, 800
RM 13	Seine 2 days per week for 28 weeks	3 people X $300 X 56	$50,400
RM 7	same	same	$50,400
Duwamish	4 days per week for 28 weeks	2 people X $300 X 112 days	$67,200
Nearshore	2 days per week for 3 months	3 people X 300 X 24	$21,600
		Total	$210,700

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